OAK MERE

CONTINUOUS MONITORING

Summary Report, 1997 to 2000

1. Introduction

A multi -parameter probe has been deployed in Oak Mere since summer 1997. From 1999 nutrient and chlorophyll samples have been taken when the water quality instrument is serviced. Water level measurements have been made since 1998.

2. Water Quality, 1998

It would have been expected for dissolved oxygen and pH to show similar seasonal patterns and be related to temperature. Water temperature fell from a peak of 23 °C in May, and again in August, to 2 °C in January. However, both dissolved oxygen and pH varied little through the year. Dissolved oxygen levels never fell below 65 % (compared to 40 % last year) and super-saturation occurred periodically through the year (maximum 120 %), including winter months. This lack of seasonal pattern was also noted last year. pH readings were similar to 1997, averaging 4.5. As with last year, specific conductivity remained steady through the year; ranging between 100 – 120 µS/cm. Since October, water level in the Mere rose.

3. Water quality, 1999

- Throughout the year dissolved oxygen in surface waters remained high and in July reached a low of 20 % sat. in bottom waters.
- Super-saturation levels of 115 % sat. in September is not atypical but a late winter high does distort the expected seasonal pattern (115 % sat. recorded in February / March). However chlorophyll a levels were uncharacteristically high in February (35 mg/l) which would provide photo-synthetically produced oxygen.
- There was little change in pH during 1999, with pH ranging from 4.3 to 5.1.
- Nitrogen and phosphorus levels remained relatively low all year. However phosphorus does appear to remain relatively steady through the year (around 50 µg/l) where nitrogen decreases (200 µg/l down to the Limit of Detection)
- Chlorophyll levels reflect the levels of nutrients available. The high chlorophyll levels in February may be a factor of the abundance of nitrogen present, (nitrate max. of 200 µg/l) and the low concentrations during the summer months (< 3 mg/l) a reflection of the low nutrient levels available. The increase in chlorophyll concentration in autumn can be expected as de-stratification occurs and more nutrients are available to the photic zone, however the December high of 50 mg/l is atypical so late in the year.

- Neither the suspended solids (maximum 6 mg/l) nor chlorophyll concentration can explain the low water clarity (0.6 to 1.8 m depth).

3.a Comparison with 1997 and 1998 data

pH has remained stable over the last two years, at around 4.6. Dissolved oxygen showed a greater variation between surface and bottom waters during summer 1999. Over the three years phosphate levels appear to have decreased and silicate levels to have increased. Nitrogen does not show any long - term trend except to say ammonia levels appear to have decreased.

3.b Water level data, 1999 data

Oak Mere is a surface manifestation of groundwater. The Mere has experienced considerable variation in water level in the past with levels lowering in recent times. This drop is due to ground water flowing to an area of heavy abstraction. However, more recent visual observations have seen a rise in water level and this is confirmed by water level data showing a rise of 0.7 m from Ordance Datum from spring 1998 until present. During the late summer / early autumn months water level shows a decrease but this is only slight and has not effected the overall net increase.

4. Water Quality, 2000

- Temperatures rose from a minimum of 3°C in January to a maximum of 22 °C at the end of July.
- Throughout the year dissolved oxygen in surface waters remained high. Super-saturation occurred intermittently from March to November, and reached over 110 % sat. on three occasions. This corresponded with chlorophyll abundance peaks, which would have provided photo-synthetically produced oxygen.
- pH in 2000 was extraordinary alkaline, with values ranging from 5.13. to 6.11, averaging 5.69.
- Nitrogen levels were particularly low between February and November, with many values at the LoD. The winter maximum reached 90 µg/l.
- Ortho-phosphorus levels remained low and stable all year, averaging 5 µg/l in surface waters and 17 µg/l in bottom waters. The two exceptions were the bottom waters in June and August when reducing conditions and stratification induced an increase in nutrient levels.
- Chlorophyll abundance showed the expected seasonal pattern in that there was a peak in April as the spring bloom occurred, a decline in summer from limited nutrient abundance, and then a second peak in October due to de-stratification releasing nutrients to the photic zone.
- Neither the suspended solids (maximum 8 mg/l) nor chlorophyll concentration can explain the low water clarity (1.8 m to 4 m depth).

4.a Comparison with 1997, 1998 & 1999 data

The biggest change in 2000 compared with previous years is the increasing alkalinity in pH. pH averaged 5.69 compared to 4.6 from 1997, 1998 and 1999. Specific conductivity is also lower, averaging 78 µS/cm compared to 96 µS/cm in 1999. Such changes tie in with the rising water level, see below. This would give a *diluting* effect to the pH acidity and specific conductivity 'strength'.

Dissolved oxygen showed a similar pattern and value to previous years. Chlorophyll abundance did not reach the same maximums as in 1999, but yet again levels were atypically high in February (30 µg/l). In 2000 it appears the trend of decreasing levels of phosphorus continued, historical increasing silicate levels appear to have stabilised at 1999 levels, and nitrogen levels, including ammonia, continued the trend to decrease.

4.b Water Level Data, 2000

Oak Mere is a surface manifestation of groundwater and experiences considerable variation in water level. Lowering of water levels over recent times appears to have reversed in the last two years. The graph shows the increasing water depth recorded at the buoy since 1997. The installed water level logger has recorded water level since 1998. 1998/9 saw an overall rise of 0.7 m from Ordnance Datum. In 2000 the graphed data shows that water levels kept rising through the year to reach a water level nearly 1.3 m from Ordnance Datum. Water levels were quite stable at 1 m for the first half of the year, dropped slightly in September / October and then rose sharply in November so readings at the end of the year reached 1.3 m. The inset graph shows water level data for the three years. There is an obvious overall increase in water level.

Physico-chemical paramters and Nutrient levels in Oakmere, 1997 to 2000

Surface water physico-chemical parameters

Year	1997			%	1998			%	1999			%	2000			%
Parameter	Min	Max	Average	Coverage	Min	Max	Average	Coverage	Min	Max	Average	Coverage	Min	Max	Average	Coverage
Temperature °C	2.8	25.3	13	44	2.8	23.2	15	59	1.9	24.1	12.4	66	3.4	22.7	11.9	75
Specific cond. µS/cm	103	122	114	33	79	122	99	59	78	118	96	61	64	98	78	70
Dissolved Oxygen %	43	115	78	21	72	113	91	59	58	116	93	55	74	115	94	75
pH	4.3	4.9	4.6	44	4.2	4.8	4.5	58	4.3	5.1	4.6	63	5.13	6.11	5.69	70
Depth metres	0.5	1.4	1.2	36	0.4	1.2	0.8	59	0.4	1.1	0.8	56	0.02	1.4	0.7	70

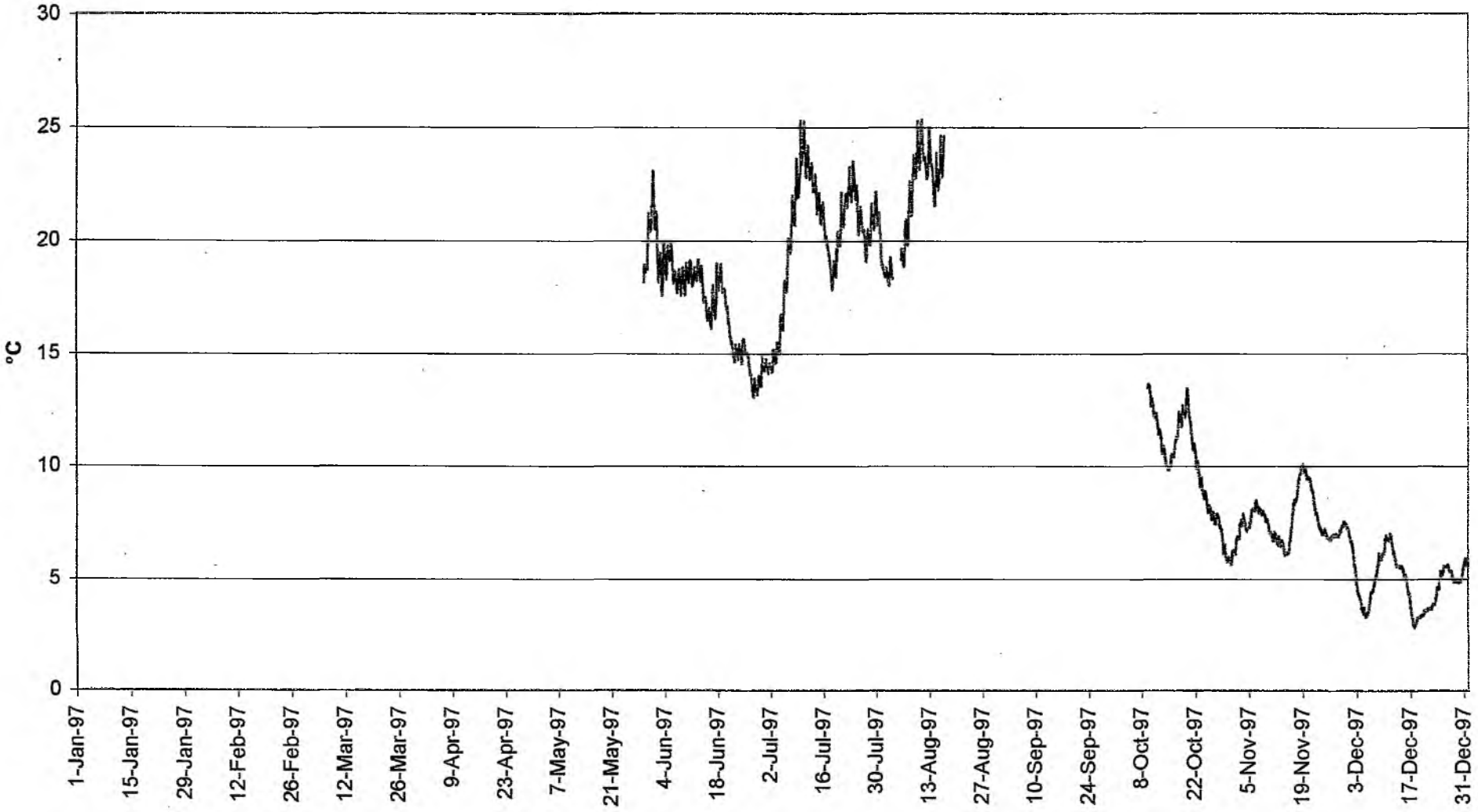
Surface water nutrient levels

	1997			1998			1999			2000		
Parameter	Min	Max	Average	Min	Max	Average	Min	Max	Average	Min	Max	Average
Secchi m										1.8	4	2.4
Chlorophyll a µg/l	2.8	17.5	9.7	4.3	15.4	8.1	3.1	48.5	14.9	3.8	34.4	14.8
Total P µg/l	45	86	61	37	54	47	23	69	48			
Ortho - P µg/l	27.2	71.7	44.8	28.1	47.8	37.3	1	37.2	15.7	1.0	16.6	5.4
Nitrate µg/l	3	241.3	121.5	3.7	429	117.5	3	201	61.2	2.5	89.7	14.9
Ammonia µg/l	18.8	63.7	45.9	13.8	119.7	66.4	5.2	119	30.8	4	201	30
Silicate µg/l	72	376	178	71	558	287	42	730	393	17	773	300
No. of samples taken	4			7			11			13		

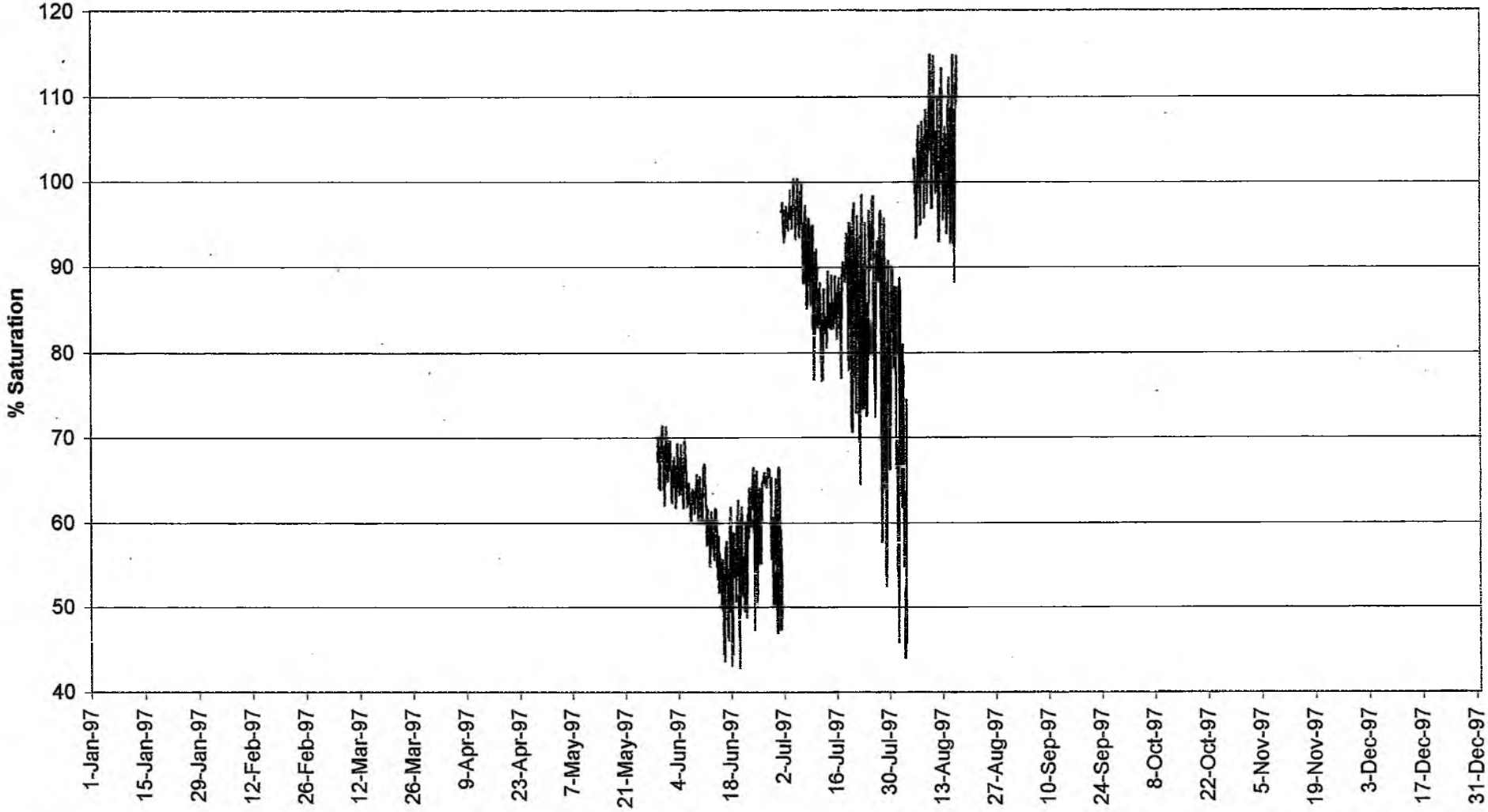
Bottom water Nutrient levels

	1997			1998			1999			2000		
Parameter	Min	Max	Average	Min	Max	Average	Min	Max	Average	Min	Max	Average
Total P µg/l	57	82	72	30	48	39	35	127	66			
Ortho-P µg/l	36.8	65.7	54.3	31.4	49.7	39.1	1	82	26.6	1	96	17.4
Nitrate µg/l	3.8	136.3	87	10.7	411.3	205.5	3	157	39.4	2.5	89	19.2
Ammonia µg/l	30.7	112.4	62.9	17.8	135.7	68.3	12.8	167	51.1	5	193	62
Silcate µg/l	73	149	111	150	327	229	352	671	481	1	745	342
No. of samples taken	3			3			6			13		

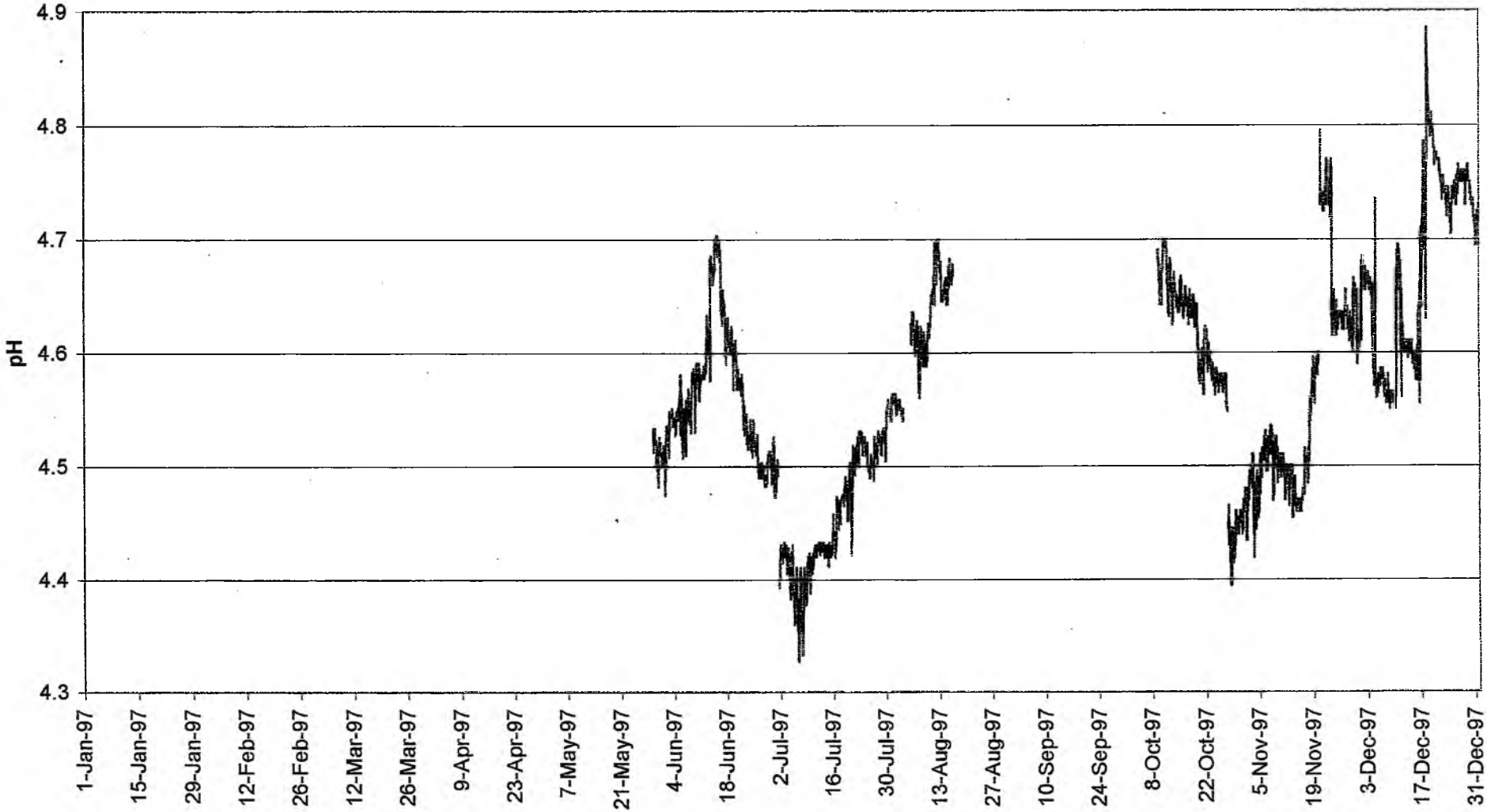
Oakmere Temperature 1997



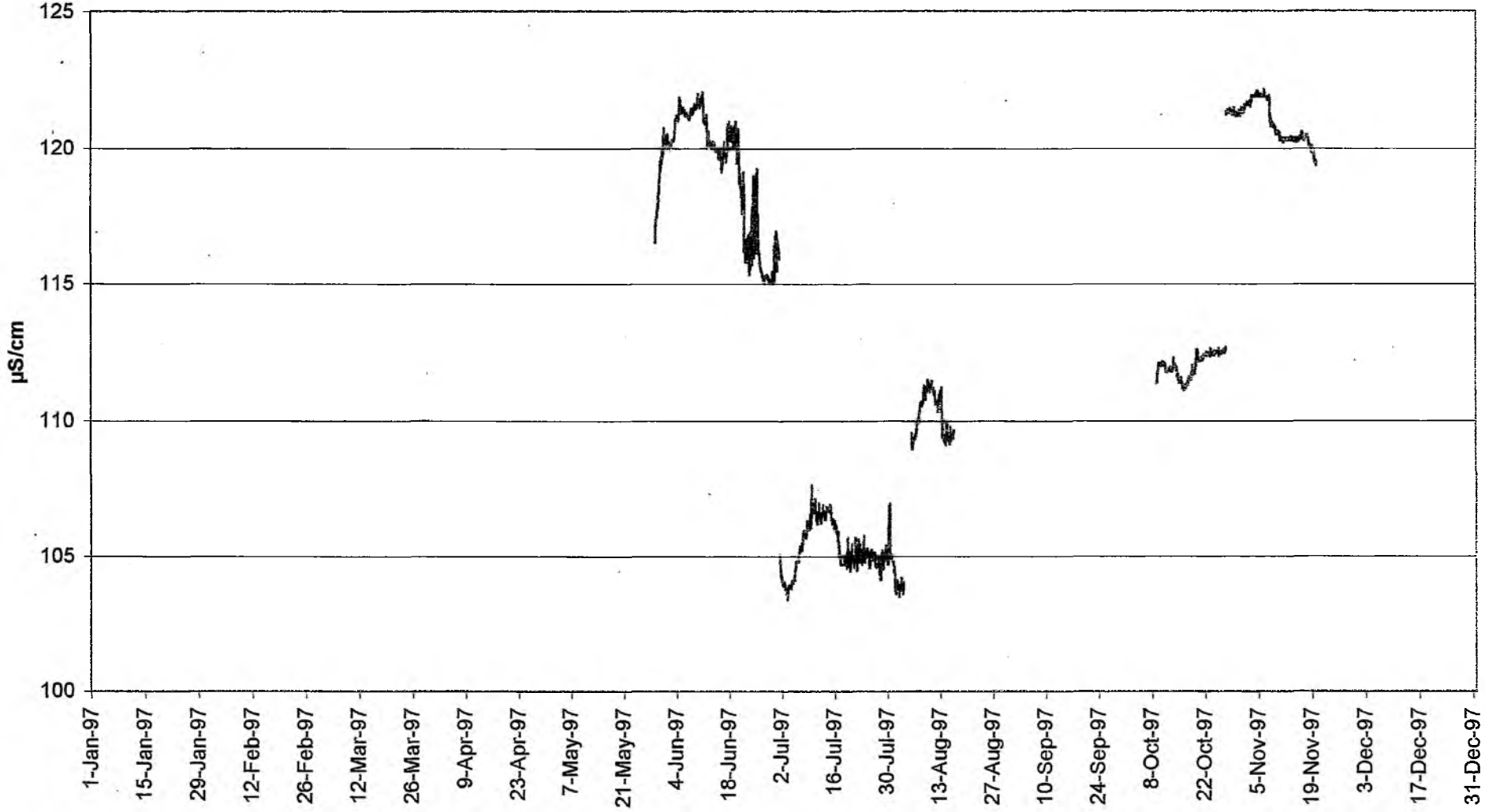
Oakmere Dissolved Oxygen 1997



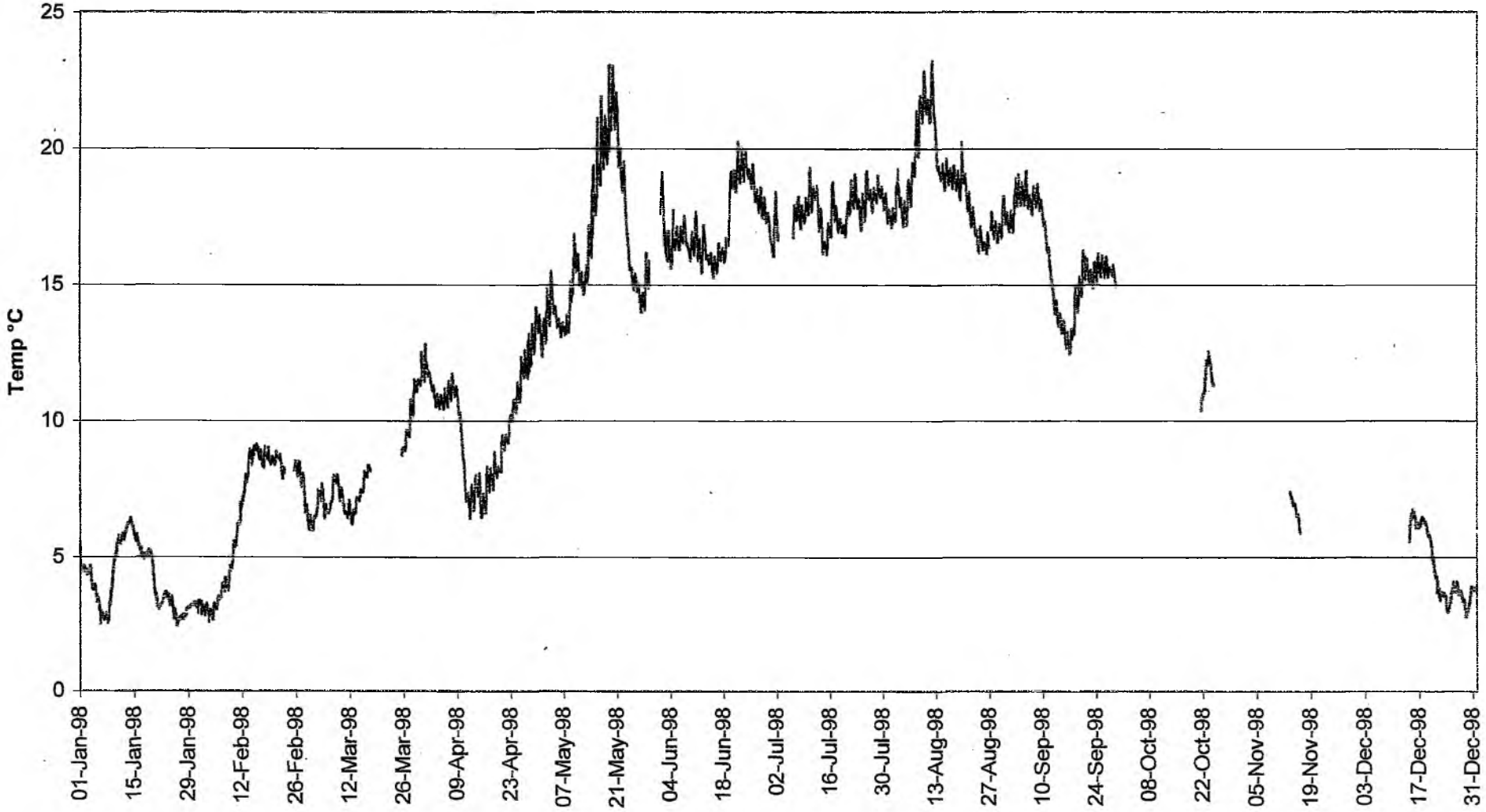
Oakmere pH 1997



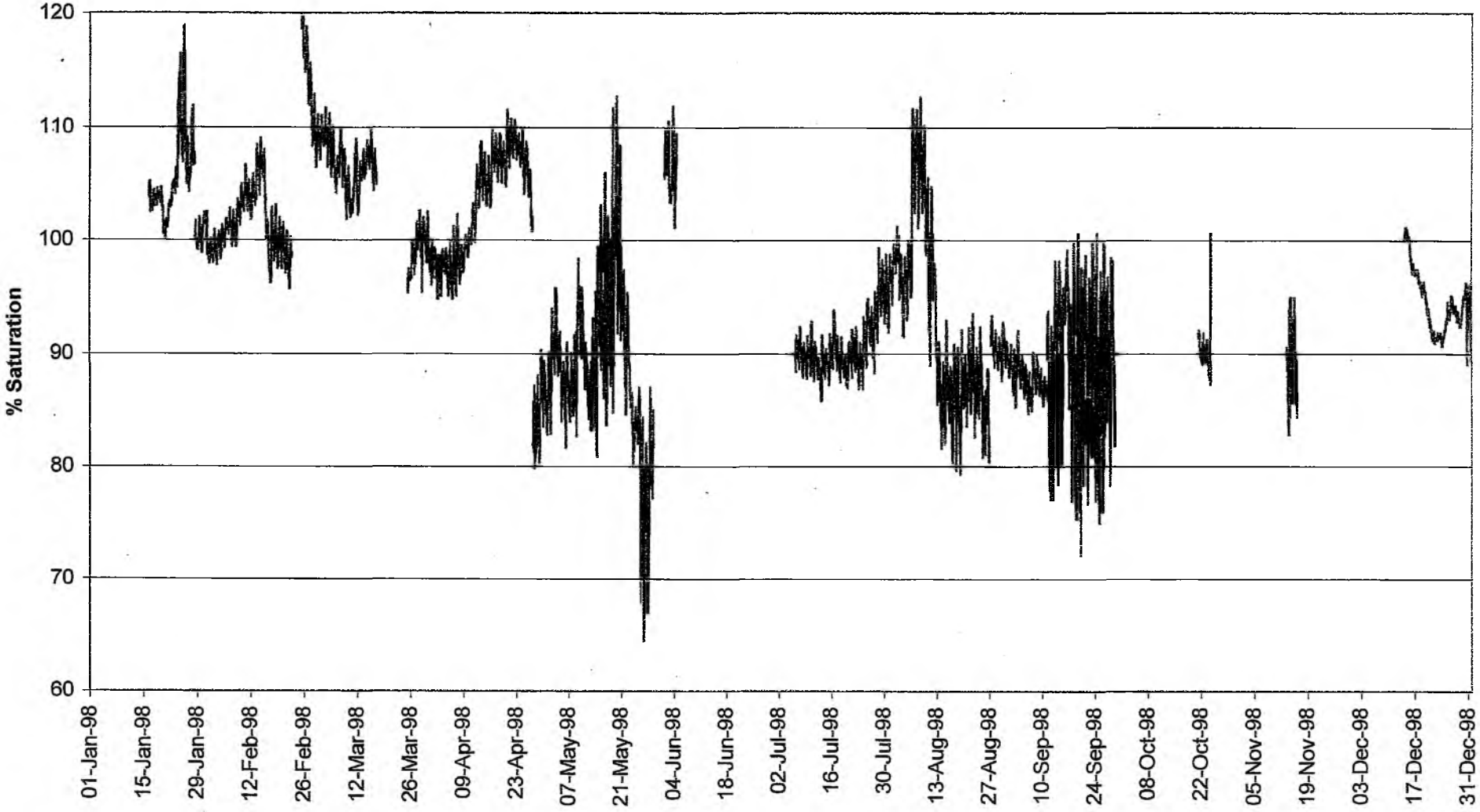
Oakmere Specific Conductivity 1997

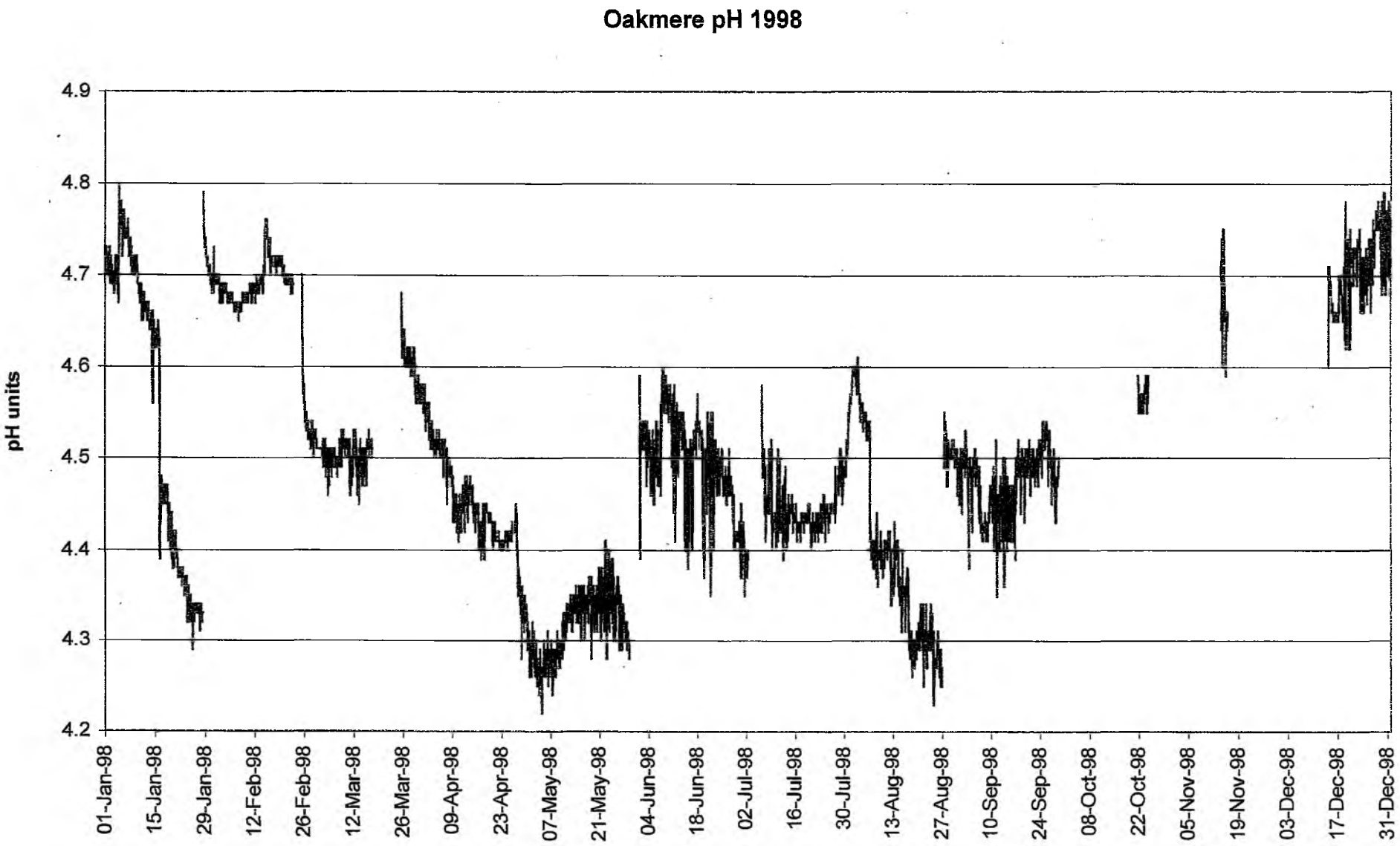


Oakmere Temperature 1998

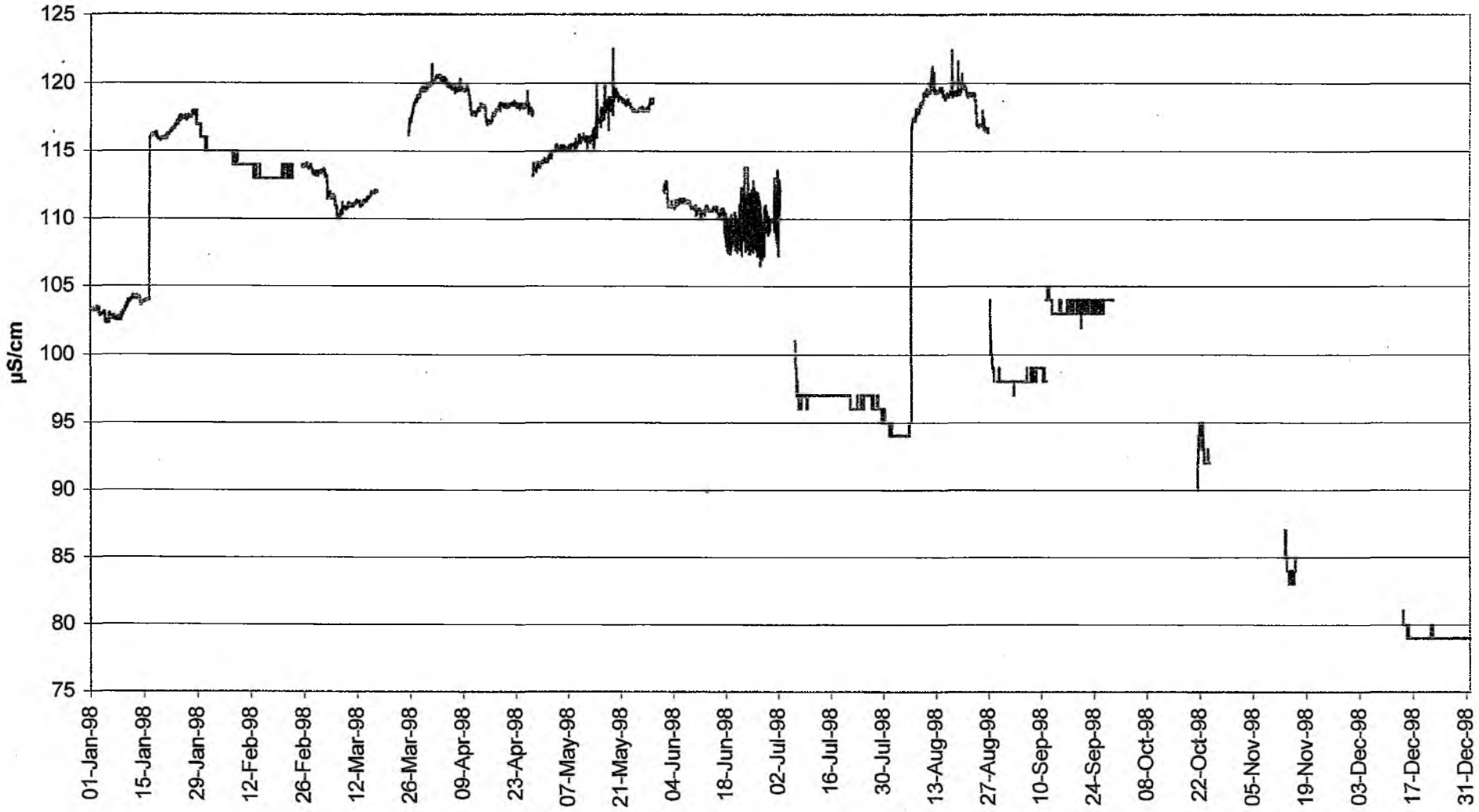


Oakmere Dissolved Oxygen 1998

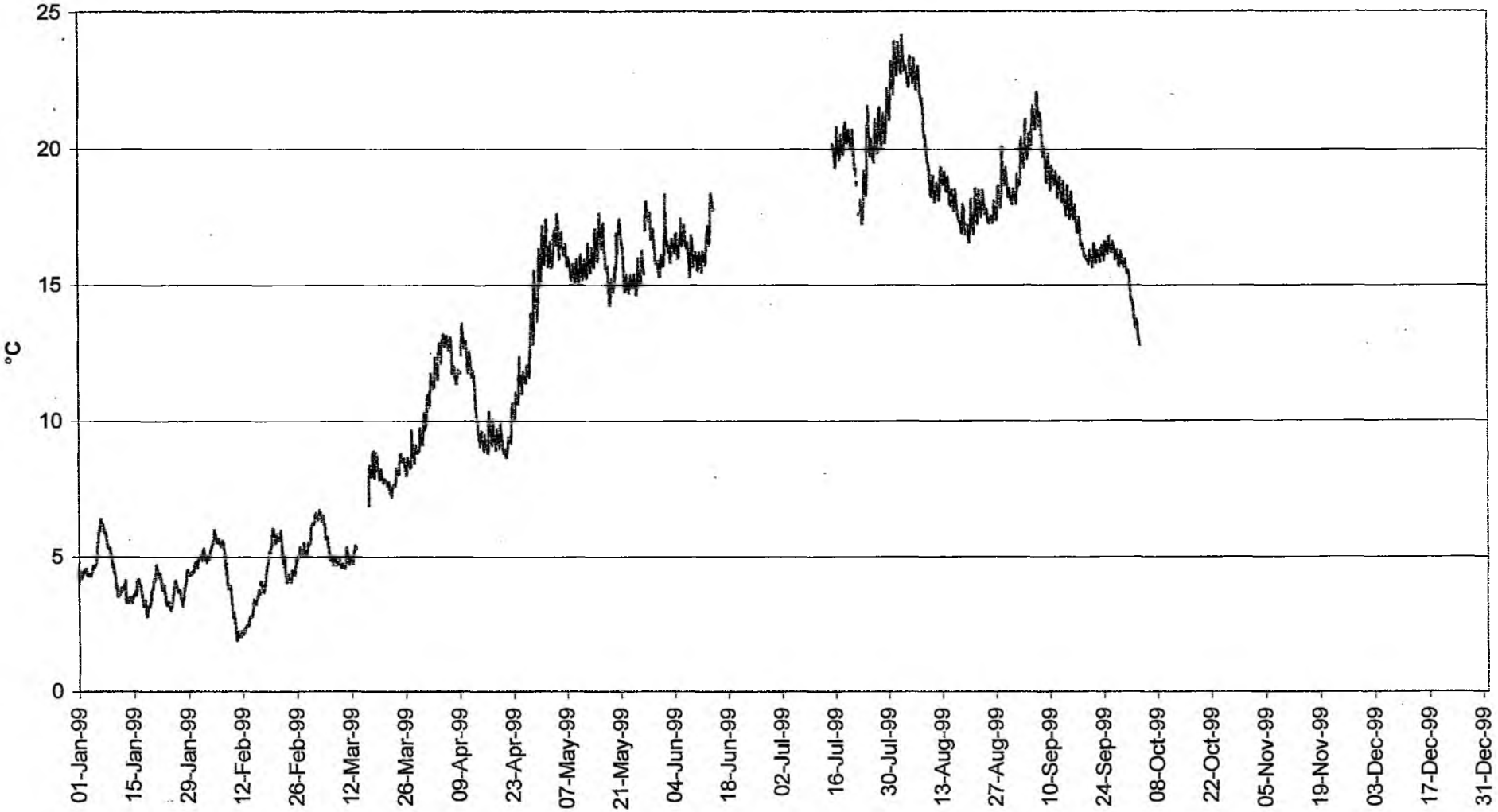



Oakmere pH 1998
pH units
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
01-Jan-98
15-Jan-98
29-Jan-98
12-Feb-98
26-Feb-98
12-Mar-98
26-Mar-98
09-Apr-98
23-Apr-98
07-May-98
21-May-98
04-Jun-98
18-Jun-98
02-Jul-98
16-Jul-98
30-Jul-98
13-Aug-98
27-Aug-98
10-Sep-98
24-Sep-98
08-Oct-98
22-Oct-98
05-Nov-98
19-Nov-98
03-Dec-98
17-Dec-98
31-Dec-98

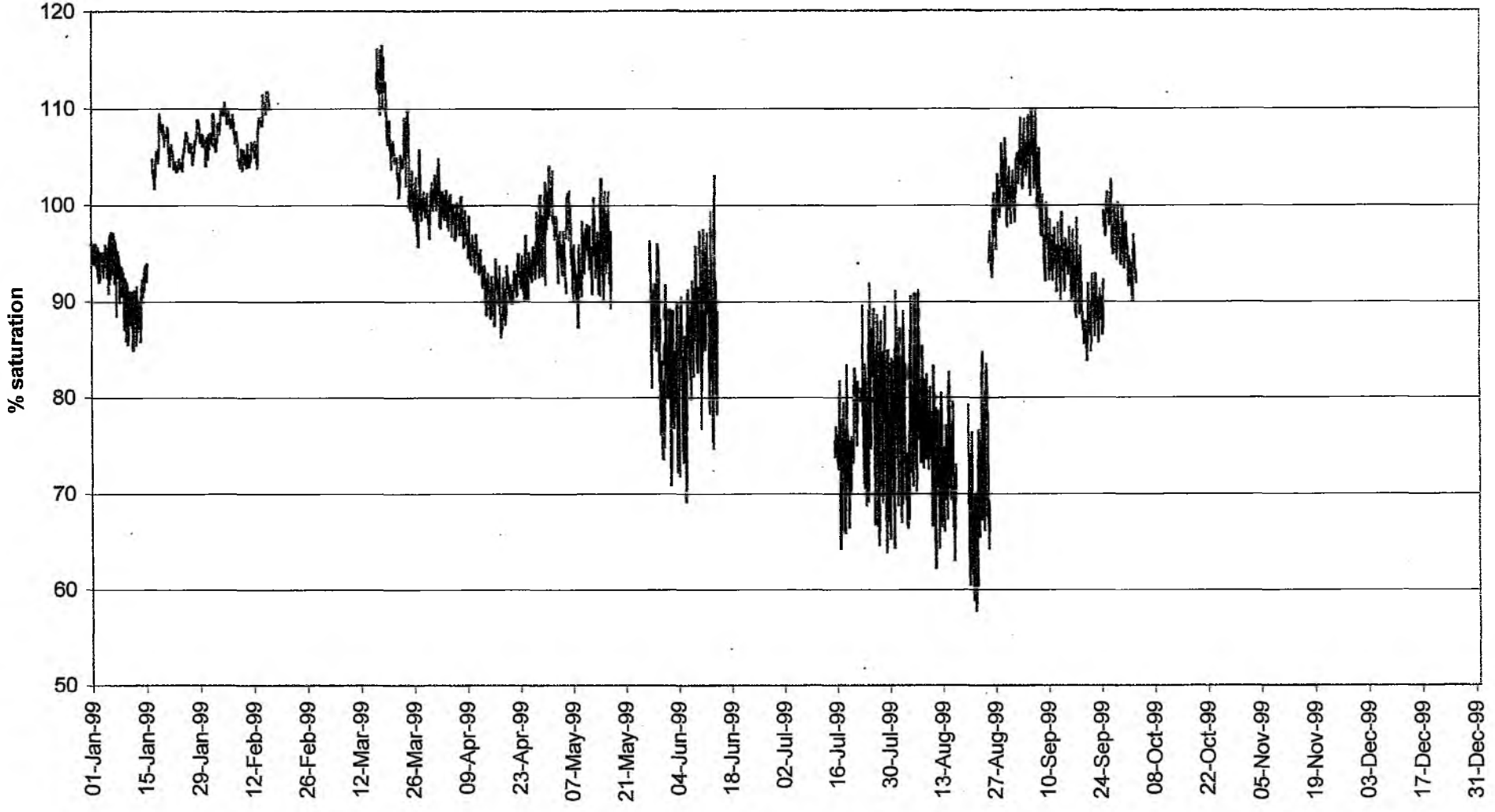
Oakmere Specific Conductivity 1998



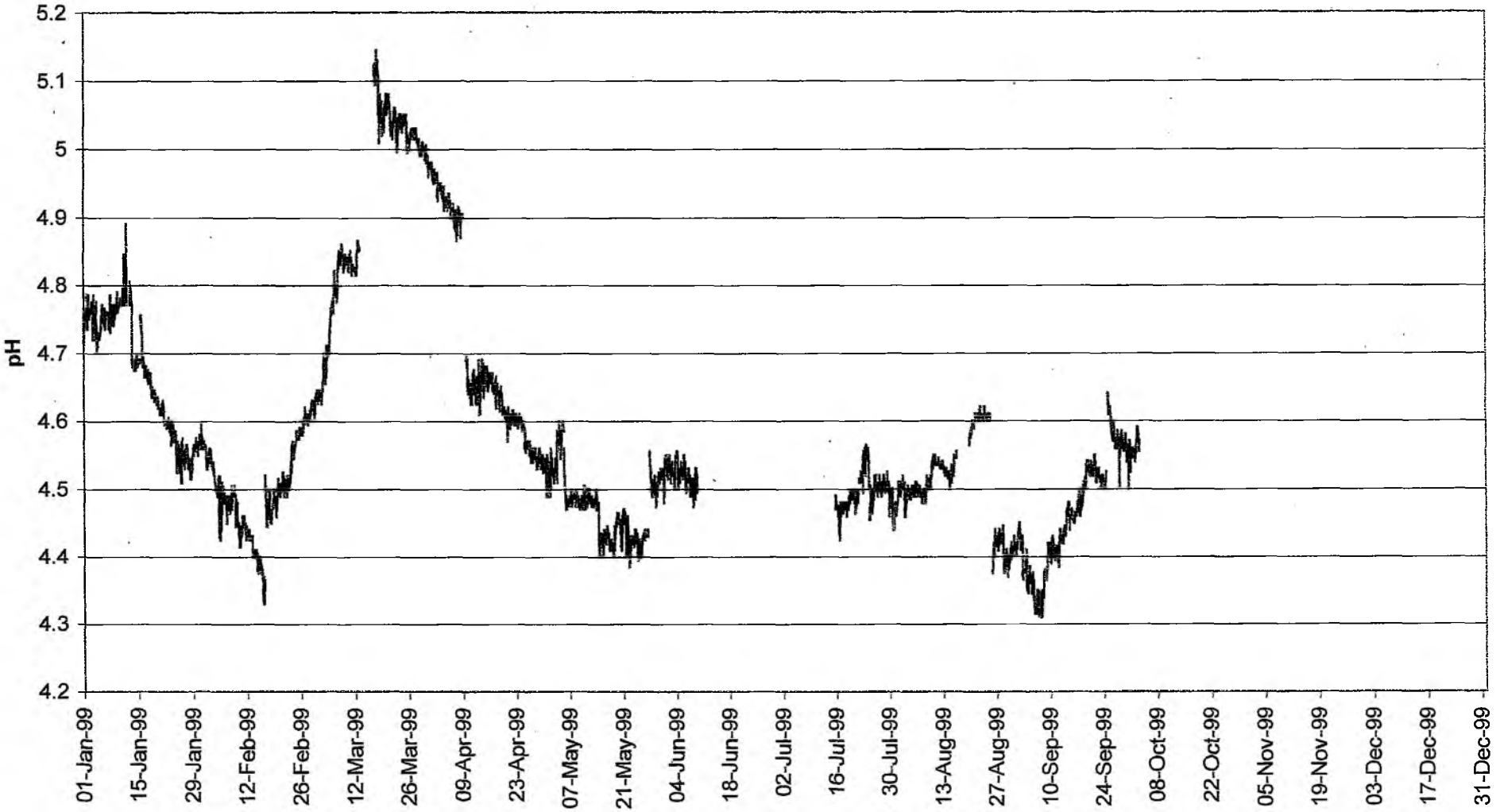
Oakmere Temperature 1999



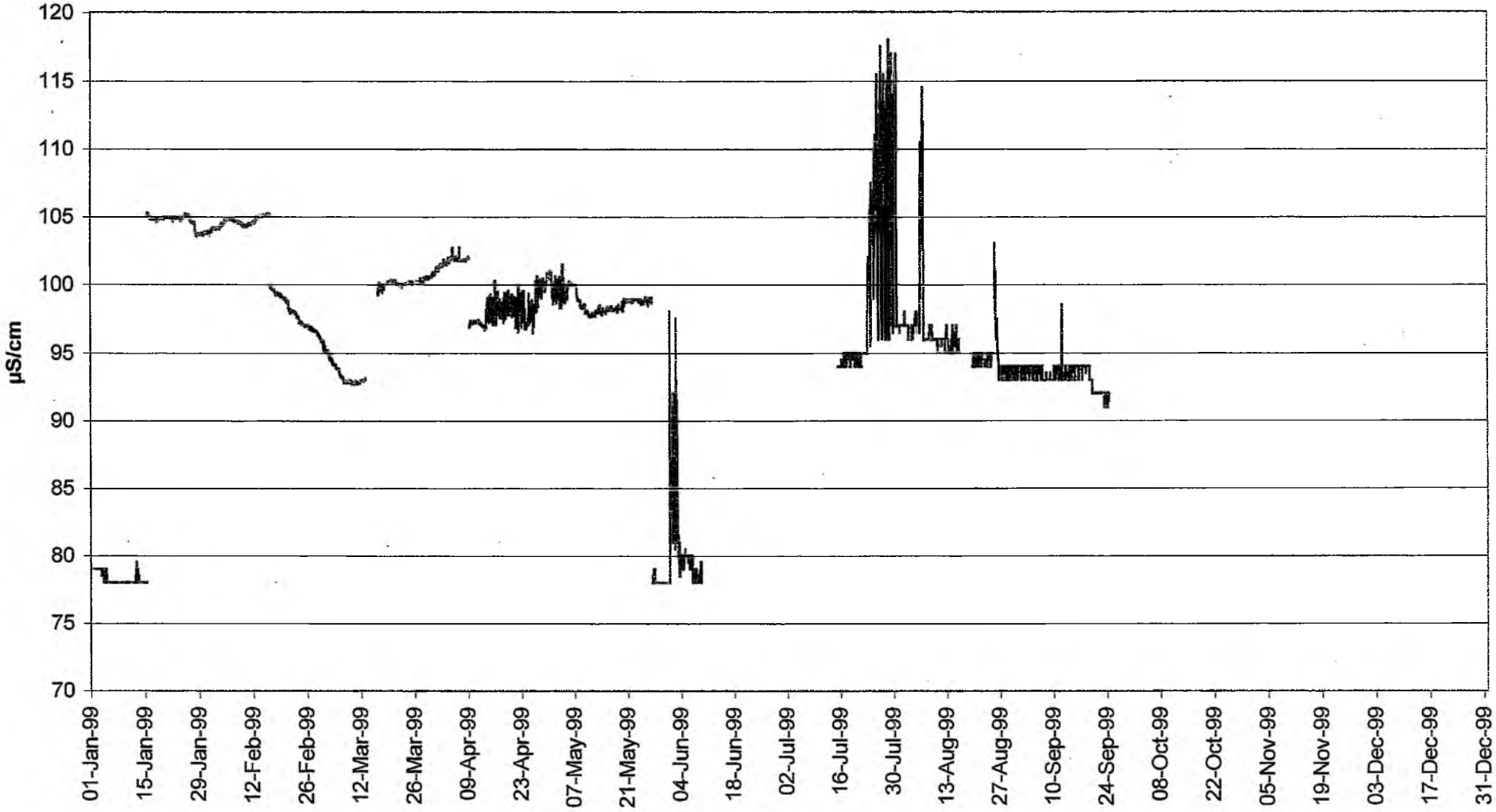
Oakmere Dissolved Oxygen 1999



Oakmere pH 1999

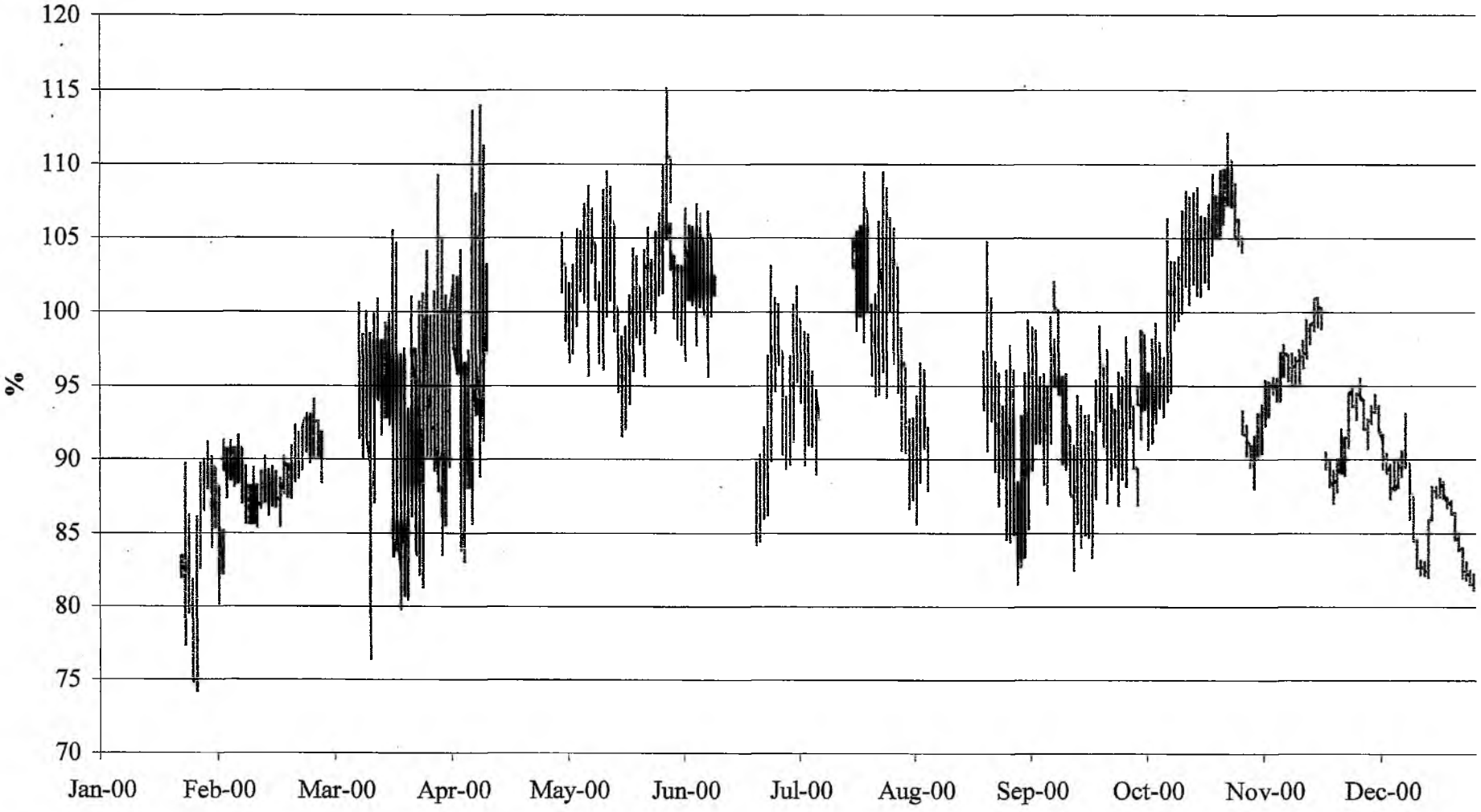


Oakmere Specific Conductivity 1999

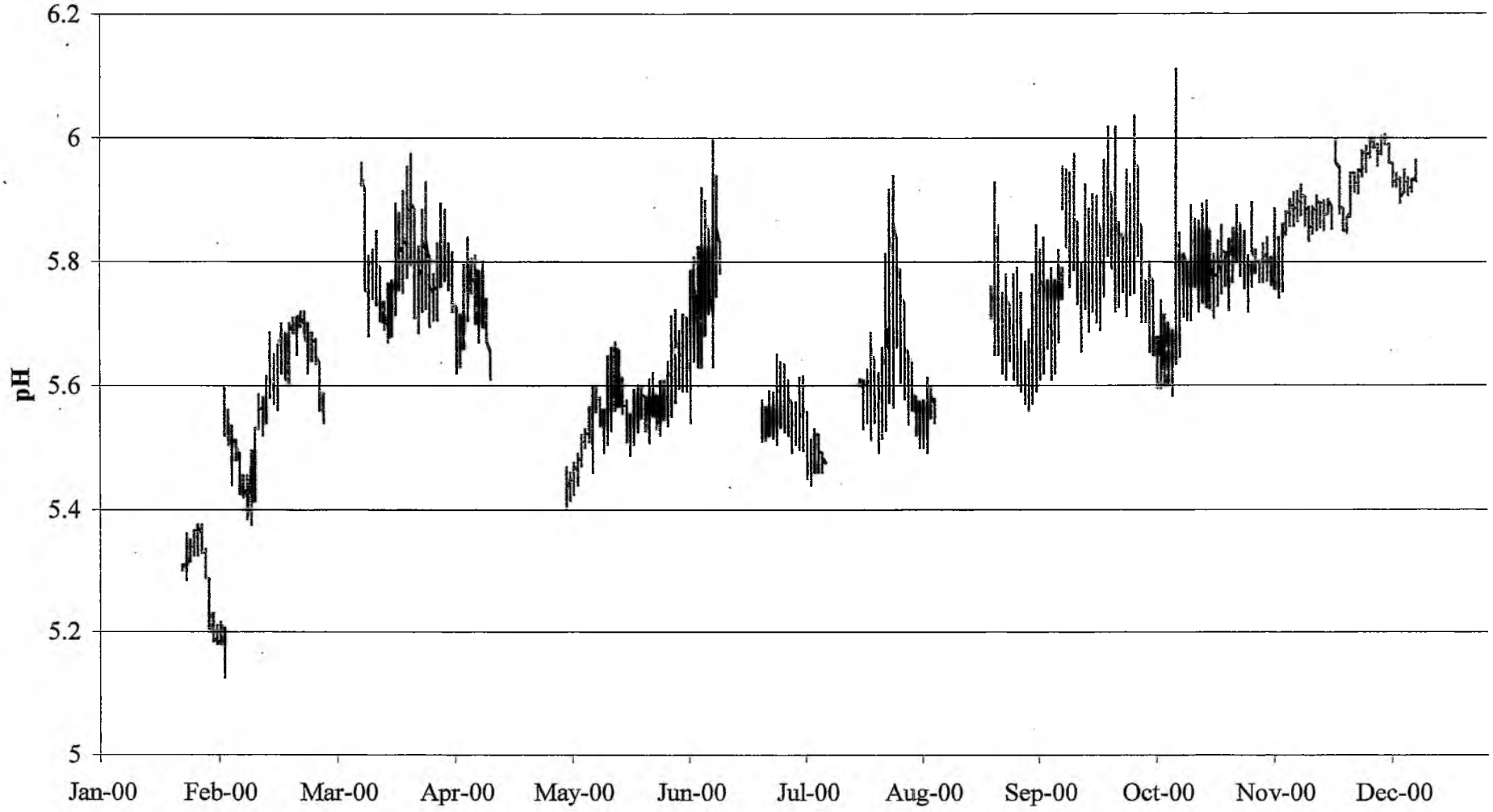


Oakmere Temperature 2000

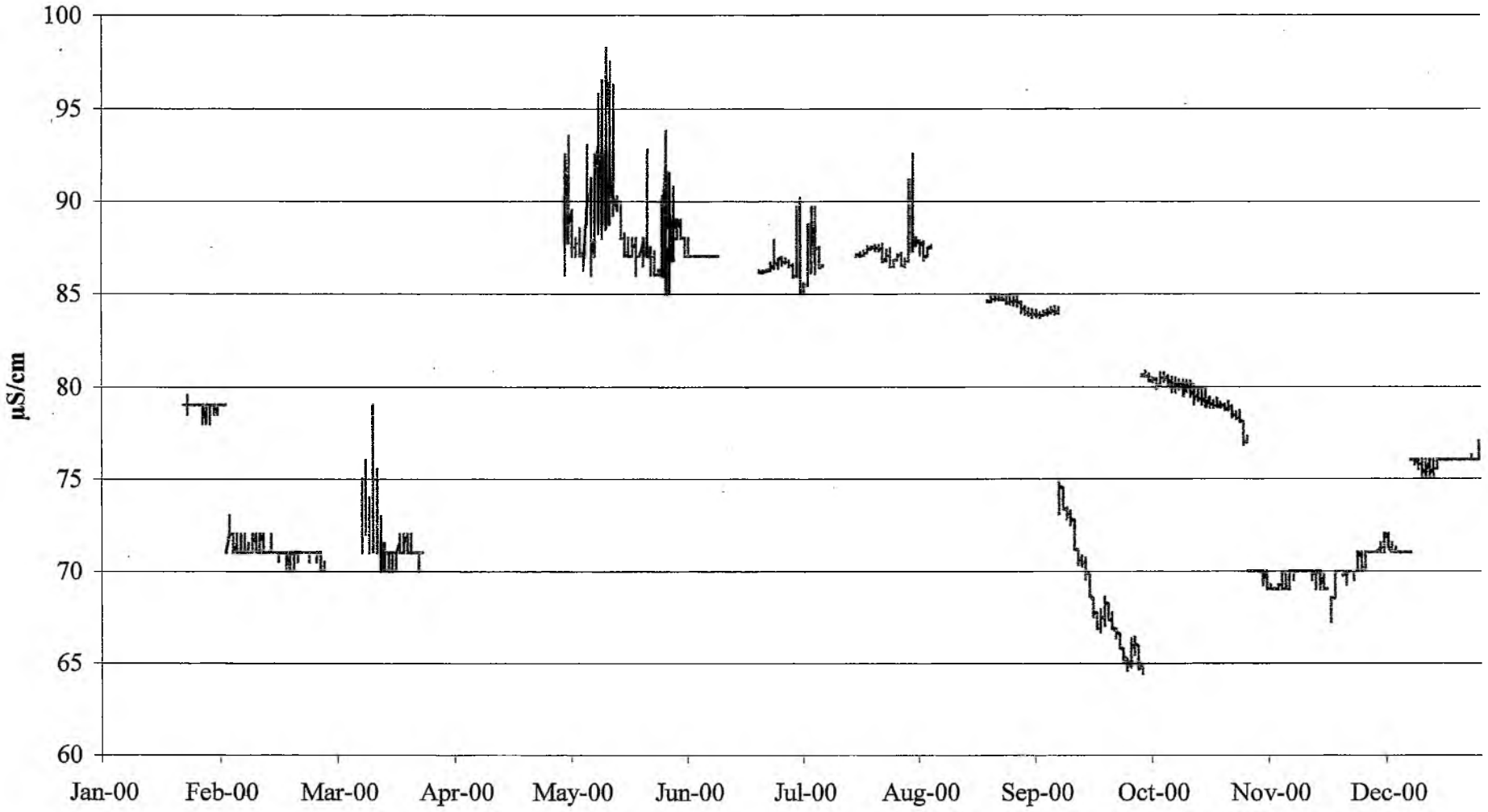
Oakmere Dissolved Oxygen 2000



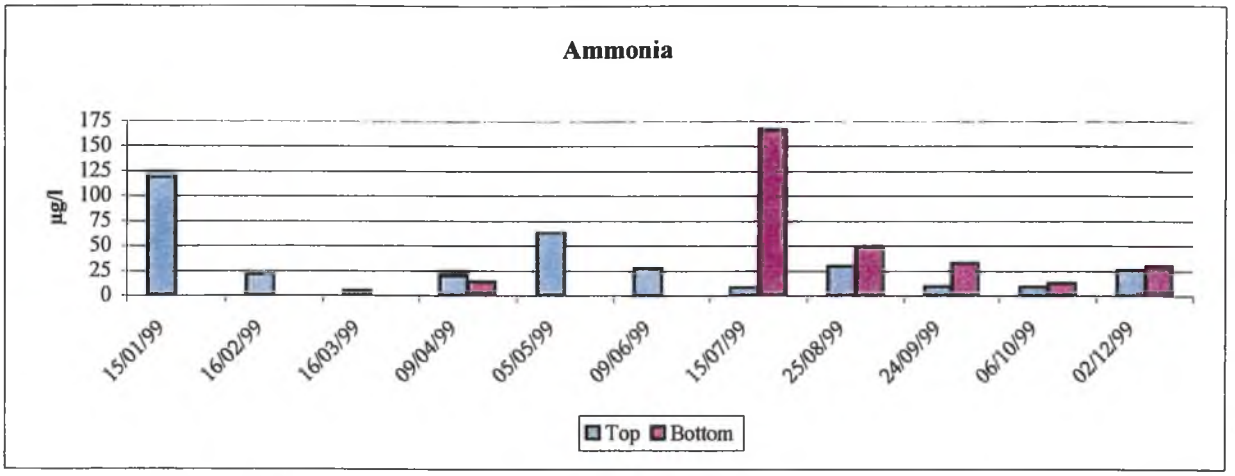
Oakmere pH 2000

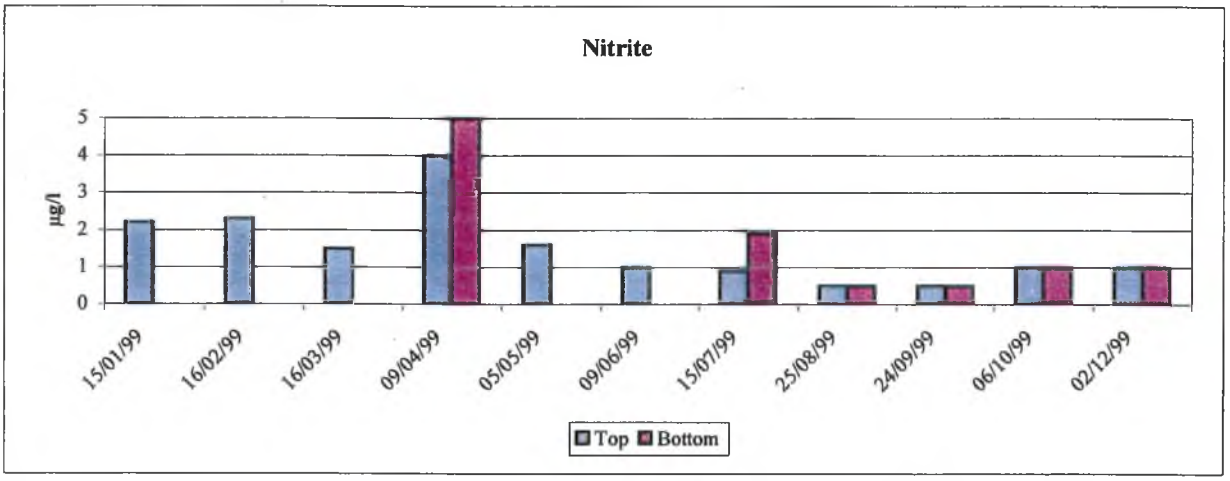


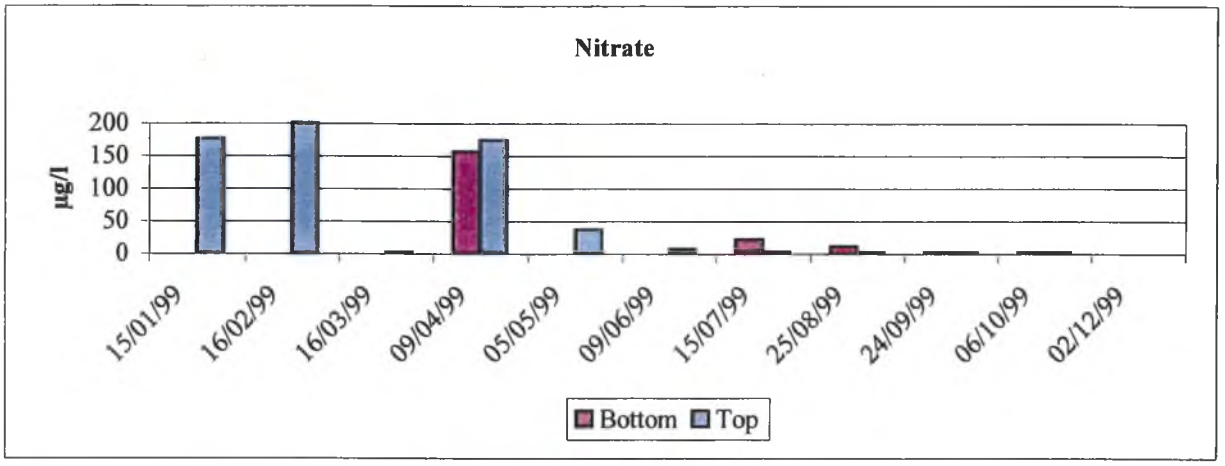
Oakmere Specific Conductivity 2000

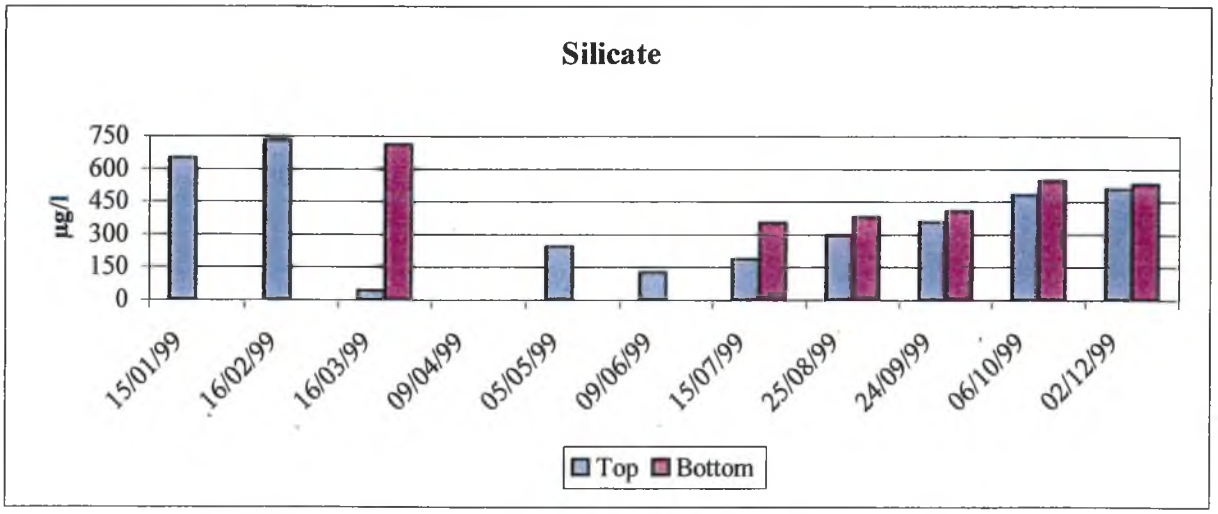


Nutrient and Algal concentrations for Oakmere 1999

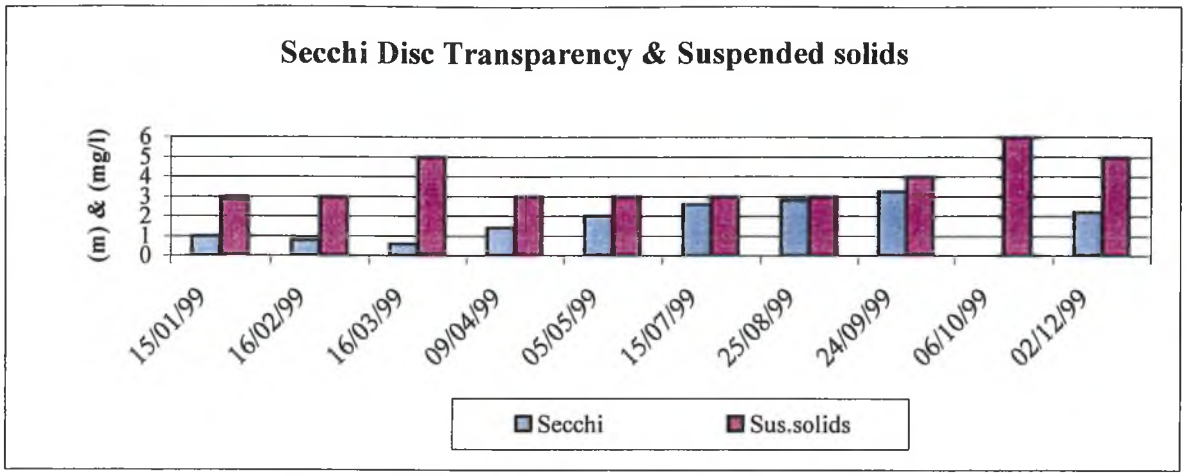


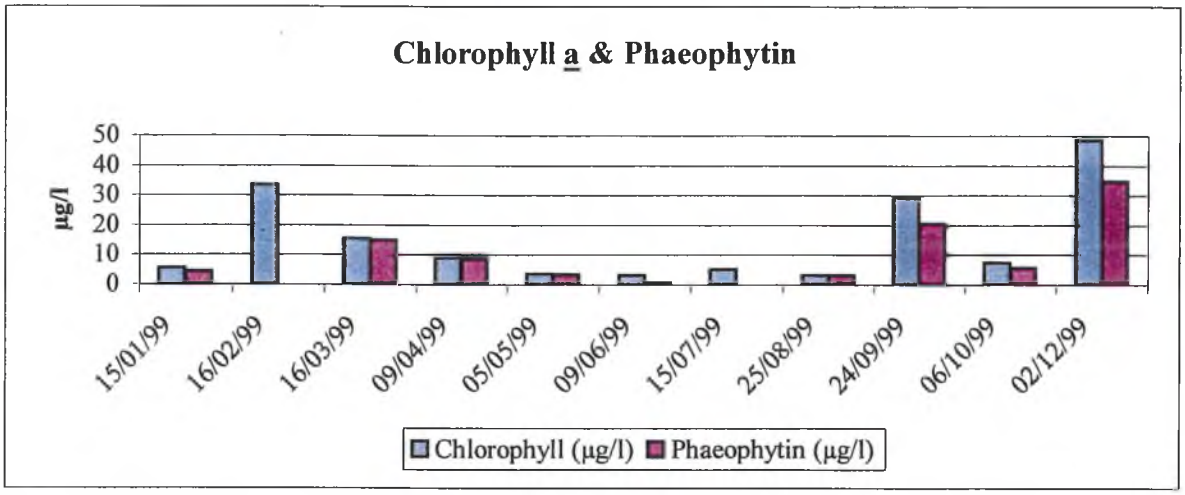


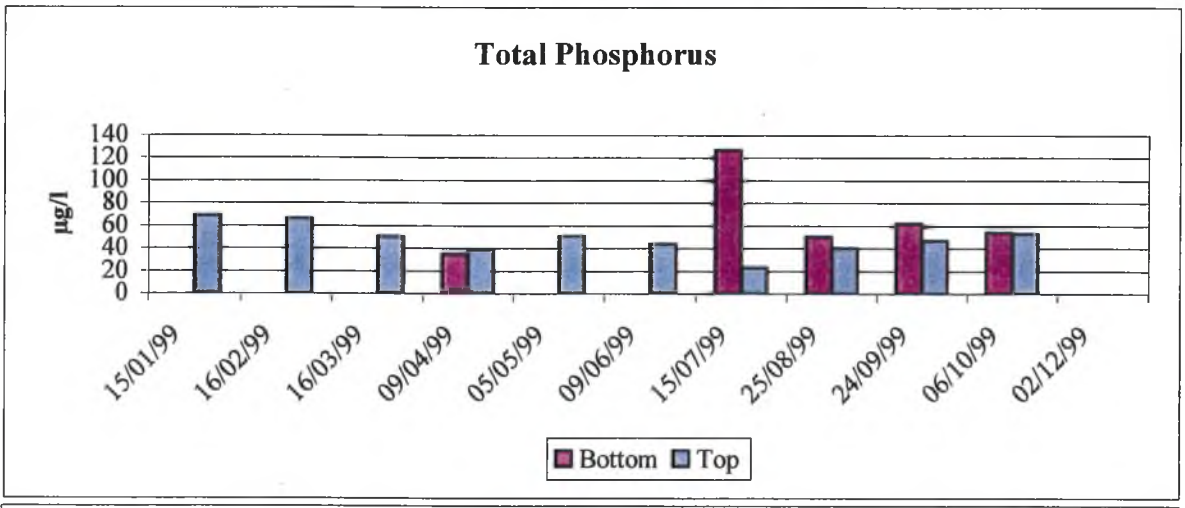


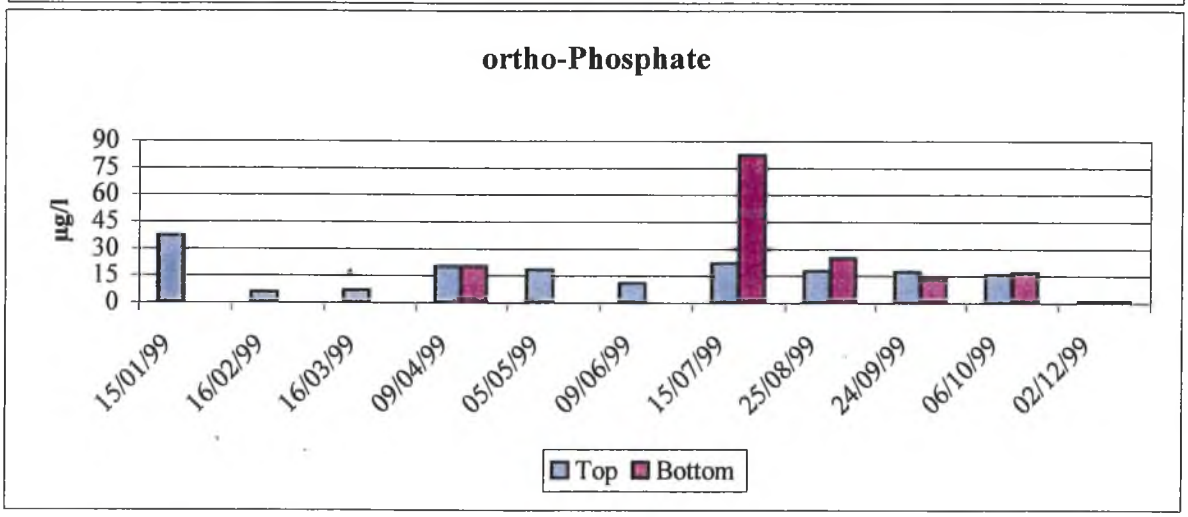


Nutrient and Algal concentrations for Oakmere 1999

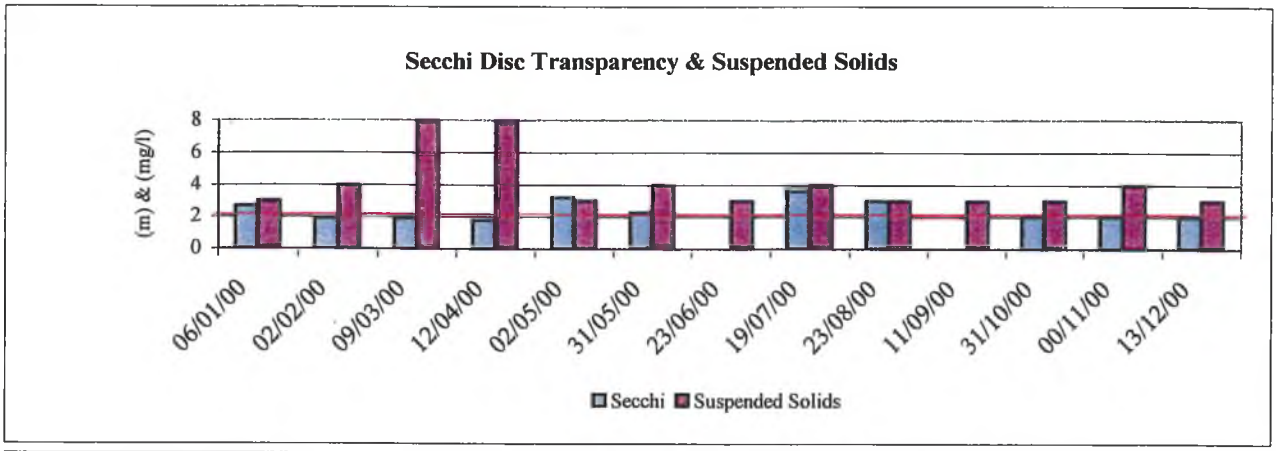


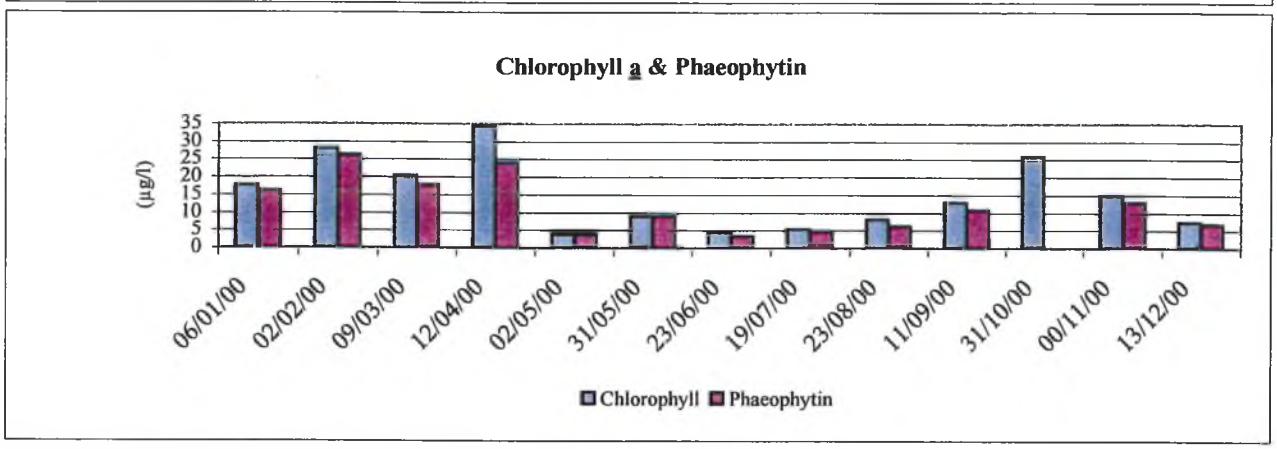


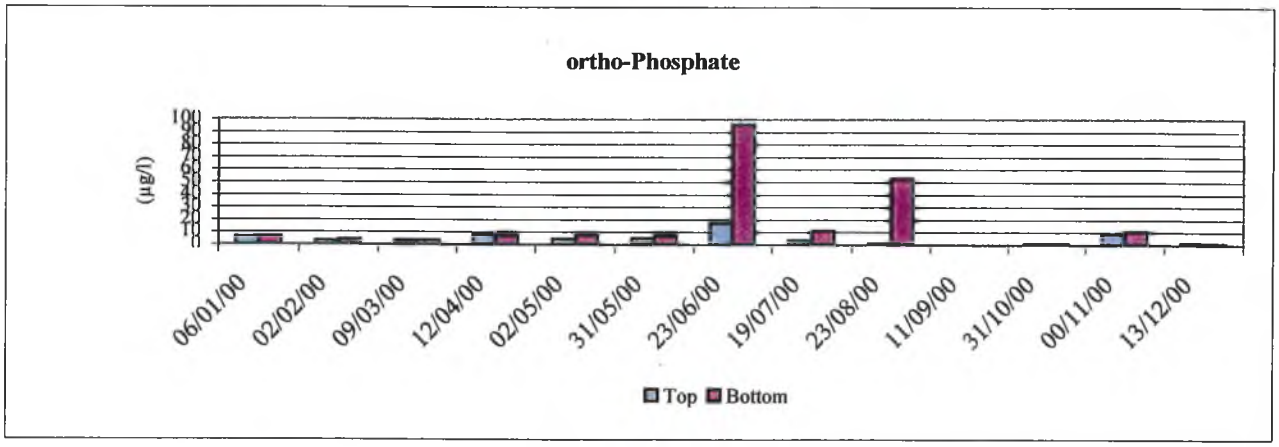


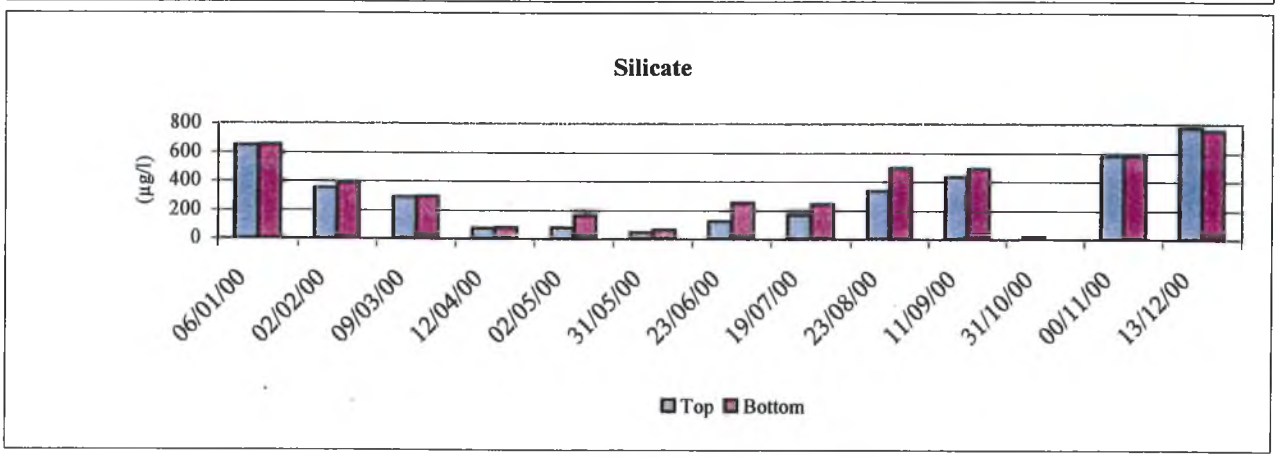


Nutrient and Algal Concentrations for Oakmere 2000

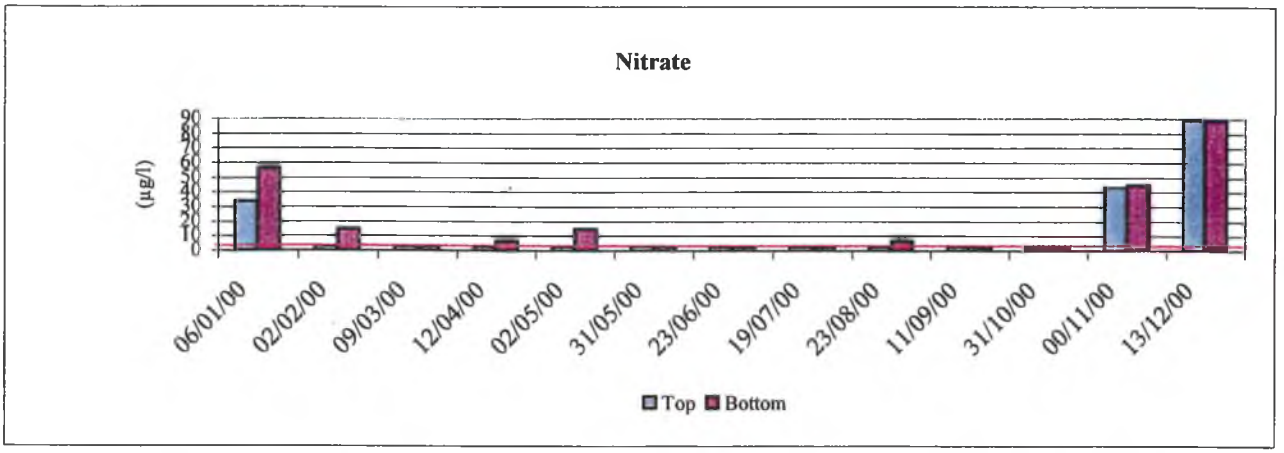


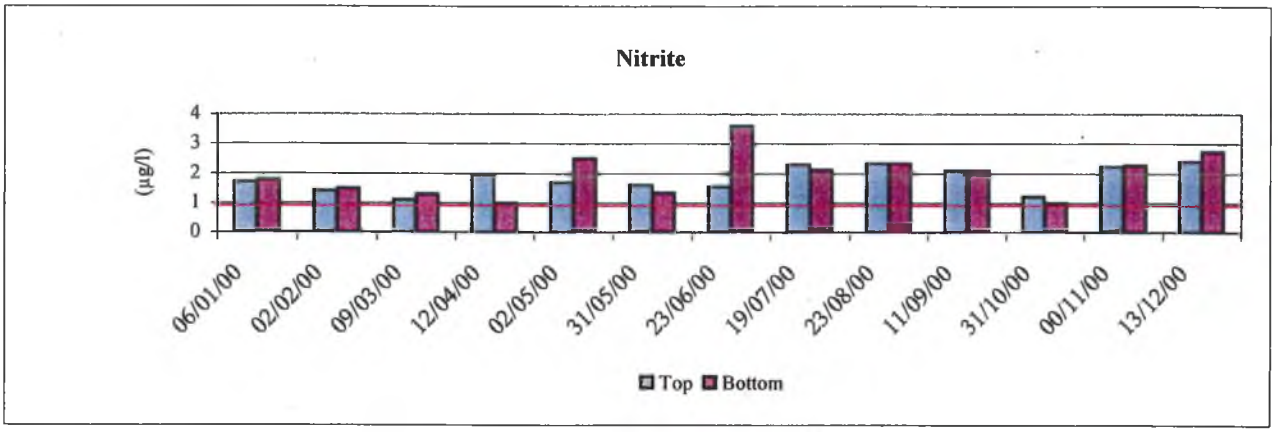


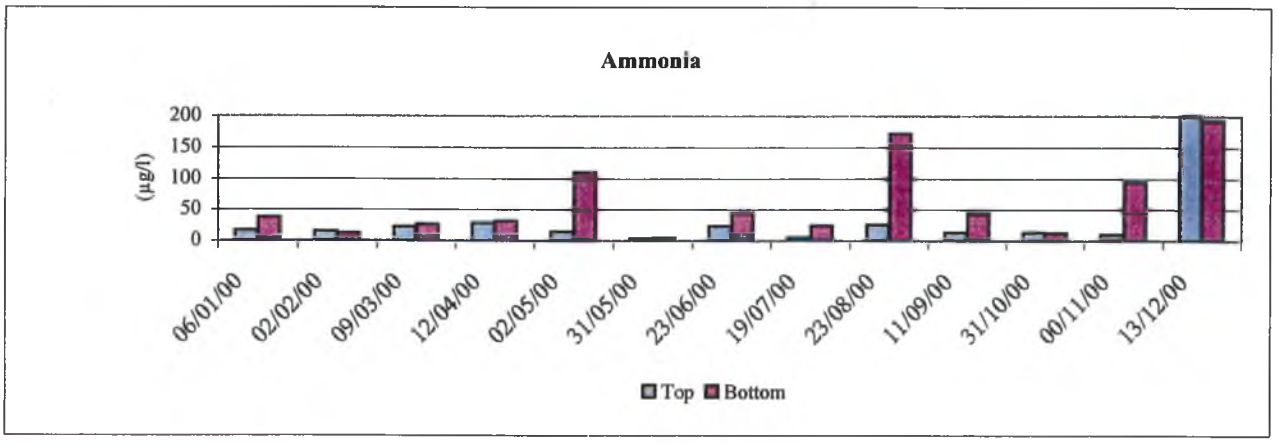




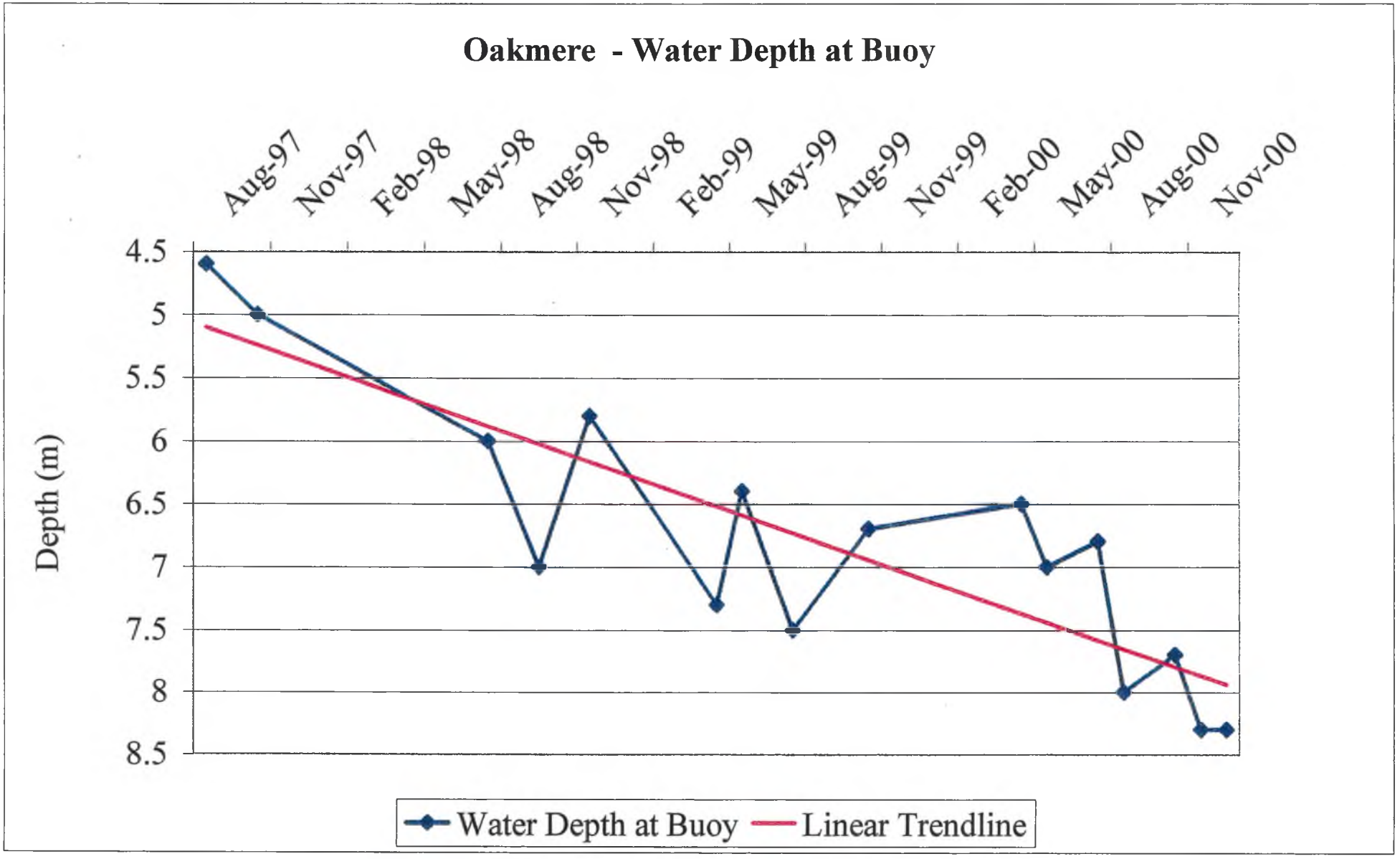
Nutrient and Algal Concentrations for Oakmere 2000, continued

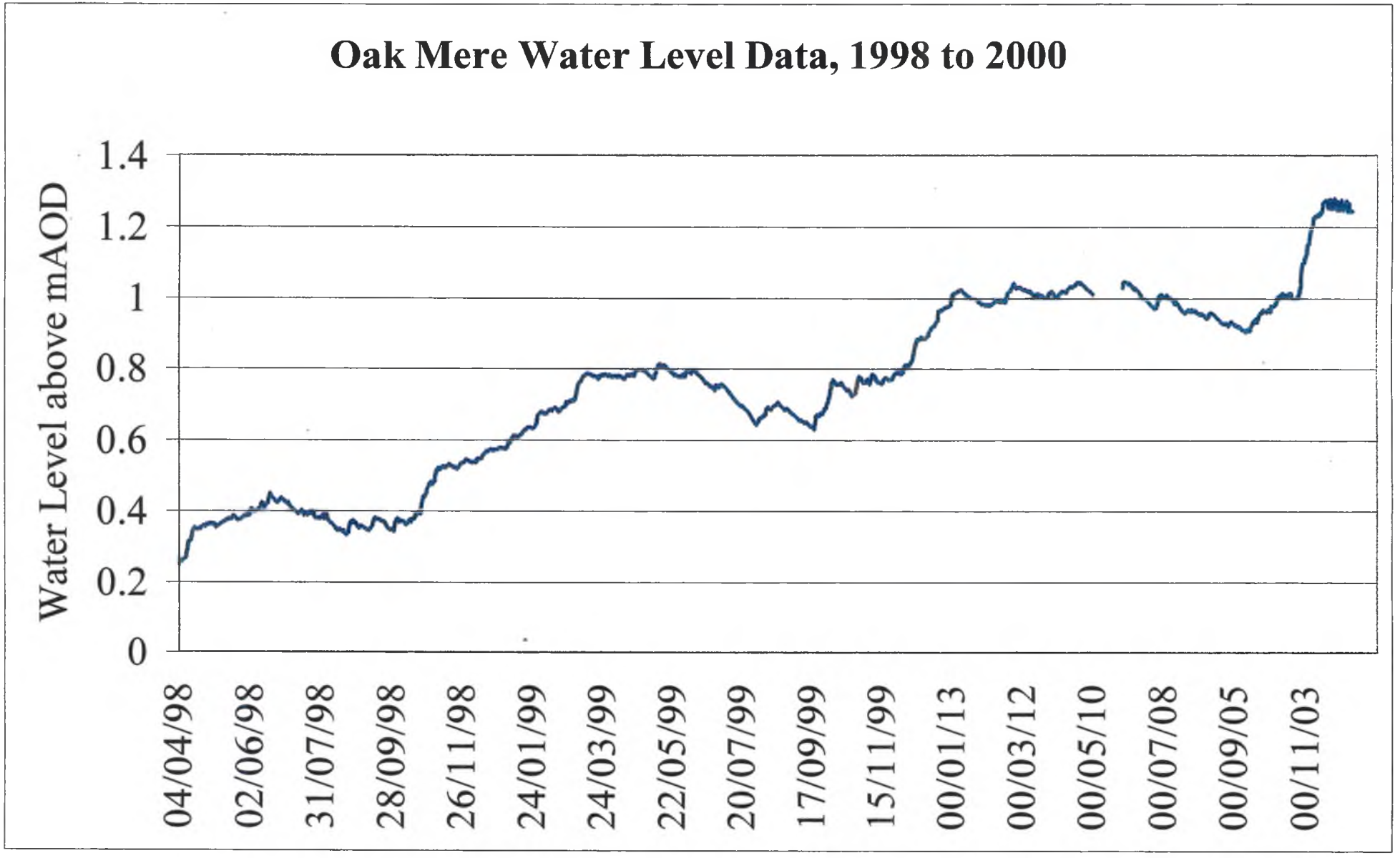






LoD


Oakmere - Water Depth at Buoy
Aug-97
Nov-97
Feb-98
May-98
Aug-98
Nov-98
Feb-99
May-99
Aug-99
Nov-99
Feb-00
May-00
Aug-00
Nov-00
Depth (m)
4.5
5
5.5
6
6.5
7
7.5
8
8.5
Water Depth at Buoy
Linear Trendline


Oak Mere Water Level Data, 1998 to 2000
Water Level above mAOD
1.4
1.2
1
0.8
0.6
0.4
0.2
0
04/04/98
02/06/98
31/07/98
28/09/98
26/11/98
24/01/99
24/03/99
22/05/99
20/07/99
17/09/99
15/11/99
00/01/13
00/03/12
00/05/10
00/07/08
00/09/05
00/11/03